

Catching crabs: a case study in local-scale English conservation

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1 Abstract

Wells-next-the-Sea and Cromer in Norfolk (England) both rely upon their local crab populations, since crabbing (gillying) is a major part of their tourist industry. Compared to a control site with no crabbing, crabs from Wells harbour and Cromer pier were found to have nearly six times the amount of limb damage. Crabs caught by the general public had more injuries than crabs caught in controlled conditions, suggesting the buckets in which the crabs were kept were to blame. Since there is much evidence that such injuries have negative impacts on the survival and reproductive success of the shore crab, this is taken as evidence of non-lethal injury from humans having a population-level effect on these animals. Questionnaire data demonstrated a public lack of awareness and want for information, which was then used to obtain funding to produce a leaflet campaign informing the public of how to crab responsibly. All data collected is available online at <http://dx.doi.org/10.6084/m9.figshare.979288>.

2 Introduction

The Wells-next-the-Sea and Cromer economies are boosted by tourists and locals catching crabs ('crabbers'), temporarily keeping them in buckets and then returning them to the sea ('crabbing', also known locally as 'gillying'). While this activity requires only the purchase of a line and bait, the crabbers (typically tourists visiting for a day) use other facilities in the local area and so provide a steady source of income for local businesses during the summer months. The crabs themselves are super-abundant, simple to catch, and easy to check for damage, while the economic effect of crabbing can be rapidly measured with questionnaires. Thus these towns provide perfect case studies of a problem that is seen time and time again in conservation: a natural resource that is being damaged by the very economy that depends on it.

The shore crab (*Carcinus maenas*, Linnaeus 1758) has been intensively investigated and is considered one of the world's one hundred most invasive species by the IUCN (the World Conservation

Union, see Lowe *et al.*, 2000). They are an intertidal species, and while adults are occasionally stranded the majority avoid leaving the water for extended periods of time, especially the smaller ($< 35\text{mm}$) individuals that rarely leave the upper intertidal zone (Naylor & Kennedy, 2003, and references therein). Males are known to compete for females, which usually cluster in ‘hot-spots’, although matings outside these areas (often with smaller males) have been documented (Meeren, 1994). Males frequently fight and are more likely to do so to determine access to females (Sneddon *et al.*, 2003). Chela (claw) strength predicts the outcome of fighting more accurately than size (Sneddon *et al.*, 2000), although relative chela size determines the likelihood of a fight being initiated (Sneddon *et al.*, 1997b). Fighting is intense from the very beginning, and is more violent in the presence of food (Sneddon *et al.*, 1997a). There is a sexual dimorphism in chela anatomy which cannot be explained by different feeding ecology and is likely related to this intraspecific competition (Spooner *et al.*, 2007). Males frequently autotomise their limbs or sustain injury as a result of these contests (Sneddon *et al.*, 2003), though it should be noted that this rarely occurs if one male is attempting to directly intervene in the copulation of another (Abello *et al.*, 1994).

Autotomy (“*a reflexive response to injury or its threat that results in the casting off of an appendage at a predetermined breakage plane*”; Juanes & Smith, 1995) has long been documented in crab species and is often used as an escape strategy (*e.g.*, Wasson *et al.*, 2002). The limb can be regenerated in subsequent moults as long as the crab has not undergone its final molt (reached terminal anecdyosis), and the likelihood of a crab shedding a limb is related to its ability to regenerate in some species (Carlisle, 1957). Chela loss can have consequences for mating success (Abello *et al.*, 1994; Sekkelsten, 1988), the strength of remaining and regenerated pincers later in life (causing a change in feeding behaviour; Brock & Smith, 1998), moult increment (Lowe *et al.*, 2000), and survival (Smith, 1995). While the loss of other locomotive limbs can be damaging, this depends in part upon the specifics of the loss, such as whether the loss is symmetrical (discussed with empirical data in Smith, 1995). Maintaining chela strength is so important that damage avoidance has been invoked to explain an apparent sub-optimality in the feeding ecology of the shore crab (Smallegange & Van Der Meer, 2003). While some workers have drawn attention to the difference between autotomy and the involuntary removal of a limb (*e.g.*, Wasson *et al.*, 2002), arguably for our purposes this distinction does not matter since the above studies measured simply the effect of missing limb(s) and not autotomy *per se*.

In the wider literature, the idea that non-lethal injury to organisms can regulate their population dynamics has been modelled and investigated to some extent in various species (Harris, 1989, and references therein). We propose that crabbing has non-lethal impacts on crabs in two ways: (1) by increasing fighting intensity and frequency due to proximity in the buckets, and (2) the physiological stress of being removed from the sea. Shore crabs have difficulty dealing with prolonged hypoxia and osmotic stress, and tolerance varies within a given population (Reid *et al.*, 1997, and references therein). In low oxygen conditions the outcome of aggressive encounters are determined primarily by carapace (shell) diameter (Sneddon *et al.*, 1998), indicating that in these conditions the limiting factor is aerobic capacity, not strength.

This study quantifies the effect of crabbing by measuring limb and pincer loss frequency at a control site versus other areas of high crabbing intensity. To determine the cause of crab injury, the crabs inside the crabbers’ buckets were compared with the crabs we caught ourselves. While doing this we were able to assess the willingness of the general public to change their methods of crabbing, as well as their general knowledge of crabs to plan conservation interventions.



Figure 1: Study sites. Wells-next-the-Sea at top (grid reference TF 915 435), Cromer at bottom (UK grid reference TF 915 435). Study sites are shaded: red—Wells harbour, blue—control, green—Cromer. Images produced from the Ordnance Survey Get-a-map service. Images reproduced with kind permission of Ordnance Survey and Ordnance Survey of Northern Ireland.

3 Methods

3.1 Study areas

Three study areas were investigated: Wells harbour, a nearby control area, and Cromer pier. All three are in the county of Norfolk, England, and are shown in detail in figure 1.

No noticeable crabbing has taken place at the control site in recent memory (Dr David Aldridge pers. obs.), perhaps because it is some distance from the main harbour and the town’s amenities. The maximum tidal range is 3.9 m (Wells harbour master pers. coms.) and the tidal currents can be extremely strong (one of our secured traps was washed away). There is little, if any, boat traffic and no boats are moored in the area.

Wells harbour is an active fishing quayside, with numerous boats moored alongside it throughout the day. The tide is of the same range and strength to the control site and some areas are fully exposed at low tide. Crabbing activity is intense during the summer months. No dedicated facilities are available for crab catchers on the quayside, but a freshwater tap is nearby. There has been a pier at Cromer for over one hundred years and the area is renowned for crabbing. The pier is purely for tourists and so there are facilities and shelter for crabbers. It is around one hundred meters in length and at its furthest point from the shore it is over twenty meters from the surface of the sea. There is no significant boat traffic in the immediate vicinity.

	Before low tide					After low tide	
	-8hrs	-6hrs	-4hrs	-2hrs	Low Tide	+2hrs	+4hrs
Day 1		Testing for rest of day					
Day 2		12 @ W	12 @ W		12 @ W	12 @ W	
Day 3		7 @ W	7 @ W		7 @ W	7 @ W	
Day 4	7 @ C	7 @ C		7 @ C	7 @ C		
Day 5		7 @ W	7 @ W		7 @ W		
Day 6	Data collection at Cromer						
Day 7	7 @ W	7 @ W	7 @ W	7 @ W			

Table 1: Outline of trap deployment schedule. Each cell square represents a two hour deployment window. In each case the number of traps deployed, followed by their location (W—Wells-next-the-Sea; c—Control site), is specified.

3.2 Trap surveys

Crab traps were thrown into the water with a fresh rasher of streaky smoked bacon tied inside as bait, secured to the quayside at a marked point with ample twine such that they came to rest on the harbour bottom. The traps were 45 cm in length, 25 cm wide and made of 5 mm diameter thin gauge aluminium mesh, with two holes that allowed the crabs access to the central chamber (through a narrowing tube 7.5 cm in diameter at the end) from which they were unable to escape. Once the traps were hauled up the carapace width, sex, and condition of the limbs of all the crabs inside were recorded, and then the crabs returned to the sea. Lengths were measured with calipers, while visual observation revealed the sex (from the abdominal segments, see Crothers, 1967) and limb condition.

Table 1 shows how many traps were deployed at a particular time at each site; note the deployments were co-ordinated with the tidal cycle. The precise locations from which the traps were deployed were kept constant from day three onwards, and were in all cases evenly spread across the study site. Each trap was thrown in sequentially with an eight minute delay as an experimenter moved from one side of each site to the other, hence the starting side was chosen at random. Except for initial test deployments, the traps were deployed for 45 minutes, a period of time determined by the need to control for the tide and the logistics of the study.

3.3 Bucket surveys

At Wells harbour and Cromer we systematically moved from one side of the study area to the other, surveying as many crabbers' buckets as possible. The time of the survey and details of the crabs were recorded in the same way as animals from our own traps. One such sweep was conducted during each trap deployment window in Wells, in Cromer once an hour, and it was usually possible to survey the vast majority of crabbers in this time. If a group was returned to, their original survey data was omitted and the survey started again from scratch. Aspects of crabbing effort (number and type of equipment and bait used and time spent crabbing) were assessed within the questionnaire survey, which is described below.

3.4 Mark-recapture technique

To estimate population size, from day four onwards randomly selected crabs collected by us and the general public were marked before release. On the first day crabs were marked with a code identifying the source of the crab on the carapace close to each pincer using metallic pen; since the ink rarely completely dried on a wet crab, the next day a bee identification tag was affixed under one pincer using quick-drying gel. The intention was to mark five crabs from each of the seven traps per day, and to mark five crabs in crabbers' buckets around the area of the traps. However, while 66 crabs were marked for recapture, at Wells only 3 were recovered, a number considered too small for reliable population estimates to be made.

3.5 Questionnaires

Participants in the bucket surveys, as well as some randomly selected people, were asked to answer questionnaires about their crabbing activities. The questions focused on what methods were being used to catch crabs, how the crabs were being treated and what economic impact the crab catchers were likely to have. While thermometers were trialled to see if they would be of use in determining the temperature of the water in which the crabs were being kept, they were found to be unreliable and so not used after the first day. Additional questions were added during the study to gauge the necessity of a campaign to educate tourists and locals about the crabs, as well as whether they would take interest in such a campaign. A copy of the questionnaire can be found in the appendix.

3.6 Statistical Analysis

All analysis was conducted using *R* version 3.0.2 (R Core Team, 2014). Each crab's damage was modelled as a function of the site from which the crabs were taken, the crab's sex and carapace diameter, the duration of deployment, and the number of crabs in its bucket or trap, using a generalised linear model with the binomial error family and canonical (logit) link function. Crab damage was coded as a binary variable: crabs missing at least one limb or pincer were classed as damaged (given a value of 1), all other (undamaged) crabs a value of 0. While the model we present contains a marginally significant term and hence is not a minimum adequate model (see Crawley, 2013), deletion of the only non-significant term did not qualitatively affect the results and so we have chosen to show the non-significant term. All *R* code used is available online (<http://dx.doi.org/10.6084/m9.figshare.979288>; Pearse *et al.*, 2014).

4 Results

Over the course of the survey 2480 crabs were surveyed, 166 of which were from the control site, 962 collected by us at Wells harbour, 1065 surveyed in crabbers' buckets at Wells harbour and 287 from buckets at Cromer. 12.3% of all crabs were missing one or more limbs. Two crab traps were lost: one due to the tidal currents, the other to entangling and subsequent crushing underneath a boat. 112 and 13 questionnaires were conducted at Wells harbour and Cromer pier respectively. All of this data is available online (<http://dx.doi.org/10.6084/m9.figshare.979288>; Pearse *et al.*, 2014).

	Estimate	Std. Error	z value	Pr(> z)
Reference	-5.170	0.68971	-7.496	> 0.0001
Wells harbour	1.204	0.60545	1.989	0.0467
Cromer	2.394	0.66381	3.606	0.0003
Tourists	0.518	0.18108	2.863	0.0042
Time deployed	-0.003	0.00137	-2.137	0.0326
Male	0.306	0.13705	2.232	0.0256
Carapace diameter	0.047	0.00584	8.093	> 0.0001
Number of crabs per trap/bucket	-0.003	0.00113	-2.797	0.0052
-6 tide	0.423	0.26187	1.614	0.1065
-4 tide	-0.119	0.27198	-0.437	0.6624
-2 tide	0.045	0.26411	0.169	0.8661
+2 tide	0.453	0.27577	1.644	0.1001
+4 tide	-0.990	0.43181	-2.293	0.0219

Table 2: Statistical model of crab damage, showing increased damage in tourists’ buckets when location, sex, and carapace diameter are accounted for. Results from a logistic regression (binomial link; residual deviance 1624.8 with 2409 d.f., null deviance 1845.4 with 2421 d.f.), fit without the intercept to make parameter estimates easier to interpret. Note that all categorical parameters (the harbours, whether the crab is in a tourist’s bucket, the sex of the crab, and the tidal cycle as described in table 1) are all *contrasts* with respect to ‘reference’. ‘Reference’ is the estimate for a female crab taken at -8 tide in the control site; thus to obtain the estimate for a male crab in a bucket at Cromer pier, the reference estimate would be added to the estimates for these factors (in this case $\approx -5.17 + 2.39 + 0.52 + 0.31 \approx -1.95$). Note that estimates are on the logit scale.

Table 2 and figure 2 show that crabs were almost twice as likely to be damaged if sampled at Wells harbour in comparison with the control site, and nearly twice as likely again at Cromer. A crab in a tourist’s bucket was almost one-and-a-half times more likely to be damaged than if the crab were taken from our traps. However, small crabs were relatively unlikely to be damaged in all cases.

35% of those asked were prepared to put more than ten crabs in a bucket at any one time and 47% were planning to spend longer than two hours crabbing (figure 3). Few people (31% of 74 people) knew how many legs a crab had or the species they were catching (only 25% of 80 people answered correctly). However, 89% would be at least interested in the idea of a sign giving information about the crabs (figure 3). 12% of people asked at Wells had freshwater and 1% no water at all inside their buckets, while no one asked at Cromer used anything other than seawater.

5 Discussion

This study suggests that crabbing has a negative impact on crabs, as measured through an increase in the proportion of them with missing limbs at Wells harbour. While the study is open to criticism on the grounds of potential pseudoreplication (see Hurlbert, 1984), the mark and recapture study was unsuccessful precisely because we couldn’t repeatedly sample the same crabs. Indeed, given we had been deploying the traps in the same position for several days when

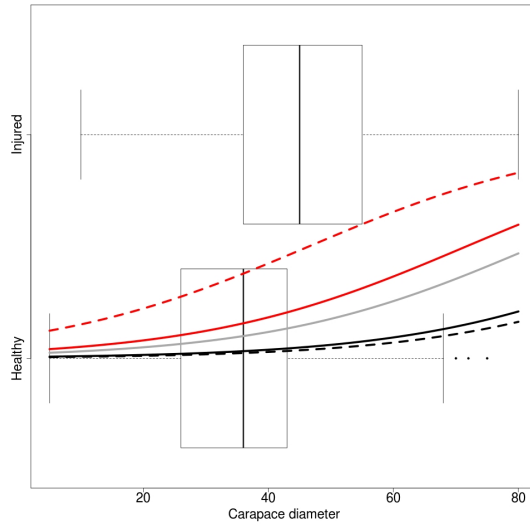


Figure 2: Plot of probability of injury in crabs. A box-and-whisker plot of injured and healthy crabs against carapace diameter, with probability of injury added using the coefficients in table 2. The black dashed and solid lines indicate probability of injury for females and males at the control site; grey indicates the probability of injury for males at Wells harbour, while the red solid and dashed lines show the probability of injury for males in tourists' buckets at Wells harbour and Cromer respectively. As shown in table 2, all lines are significantly different from one-another.

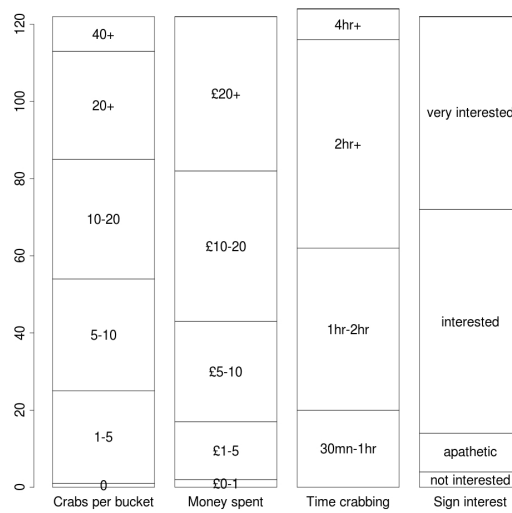


Figure 3: Questionnaire results. Results from four survey questions; the vertical axis indicates the number of responses in each category.

we started the mark-recapture study, any behavioural bias towards the traps would surely have been readily noticeable.

5.1 The cause: the buckets

The conditions in the tourists' buckets were causing stress to the crabs in four ways: the temperature (1), salinity (2) and oxygen content (3) of the water, and the density of crabs (4). While crabs are naturally exposed to similar stressors as a result of the tidal cycle (described in Crothers, 1968; McMahon, 1988), they are of much greater magnitude in the buckets and interact such that they would likely stress the crabs more. Moreover, while crabs differ in their exposure depending on age (Naylor & Kennedy, 2003), molt state (Reid *et al.*, 1997) and sex (Crothers, 1968), these factors do not appear to directly correlate with probability of capture.

(1) While thermometer readings were not taken, 47% of people were crabbing for more than two hours and there is no shade at Wells harbour. Elevated temperature affects the acid-base balance of crabs' blood in anaerobic conditions (Truchot, 1973), and although compensation occurs within 16 hours the oxygen carrying capacity of the blood is reduced at higher temperatures (Dejours *et al.*, 1985). Thus temperature could worsen an individual's reaction to hypoxia, and is known to increase vulnerability to other stressors (*e.g.*, Camus *et al.*, 2004).

(2) 12% of the buckets in Wells contained freshwater, which is known to be an osmotic stress for the animals. Shore crabs are not able to regulate the osmotic pressure of their haemolymph in 20% seawater and certainly not freshwater (Reid *et al.*, 1997, and references therein). They show an active preference for more concentrated seawater, distinguishing between salinity differences of only 0.5‰ (McGaw & Naylor, 1992). The freshwater tap at Wells harbour could therefore be causing a problem.

(3) Considering the number of the crabs and the amount of time spent in each bucket the water was likely extremely hypoxic. Even when overcrowded, buckets of immobile crabs become noticeably more active when fresh, oxygenated seawater is added. Shore crabs are known to attempt to leave hypoxic water and 'bubble', a mechanism by which air is brought into the branchial cavity to supply the animal with oxygen (Reid & Aldrich, 1989). The crabs were frequently not able to do this, either because they were buried beneath other individuals or because the sides of the bucket were so slippery. Tolerance to hypoxia varies with tidal state, seemingly partly through an anticipatory mechanism (Aldrich, 1986), likely leaving the crabs more vulnerable to this stress at some times than others.

(4) 55% of those surveyed were willing to put more than ten crabs in a bucket at one time, conditions that often resulted in aggressive interactions between individuals. That the smallest crabs were most commonly found at the bottom of the buckets could be due to gravity or fighting for access to air. In many of the more densely-packed cases free-floating limbs could be found at the bottom of the buckets along with a strong smell of ammonia. Males are known to be aggressive (Sneddon *et al.*, 1997a) and the sight of a male with a female, or the pheromone of a female, is known to make males fight more vigorously (in one study 40% of encounters resulted in injury; Sneddon *et al.*, 2003). Thus close proximity should be expected to increase the likelihood of aggressive encounters.

5.2 The effect: missing limbs

We therefore propose that the increase in damage in crabbers' buckets in comparison with our crabs is the result of the conditions in the buckets, and that this damage is the cause of the increase in injured crabs at Wells in comparison with the control site. While there was greater boat traffic at Wells harbour, this disturbance likely paled in comparison to that caused by tidal currents to which the boat traffic was related anyway. The effects of an increase in autotomy, as outlined in the introduction, are detrimental to a crab population.

Most of the damage is likely due to fighting between crabs, which is supported by the greater frequency of injury within a bucket containing more crabs. That substantially more male crabs should be injured than females is also very suggestive since they are the most aggressive sex (Sneddon *et al.*, 1997a). Unlike in the turbid waters of the harbour (where the visibility was roughly 30cm), fleeing was extremely difficult (a survival strategy documented in Smith, 1995) and so autotomy is likely the only means of evasion. Moreover, hypoxic conditions increase the energetic cost of fighting (Sneddon *et al.*, 1998) such that individuals might be more likely to autotomise for self-preservation. It is also possible that the other stressors directly caused damage, especially if the crabs were exerting themselves by fighting, reducing the general condition of the crabs and so increasing the likelihood that they would need to autotomise once released.

There are three main alternatives to this explanation. (1) The crab catchers introduced a bias towards larger crabs (which were more frequently injured) since they were unlikely to feel or see a smaller crab 'biting' and so wouldn't catch them. Crabbers' crabs were indeed larger, although when size and sex are controlled for in our analysis their crabs are still more damaged. (2) The crabs were competing underwater for the food, such that the weaker individuals, *i.e.* those that are missing limbs, were less likely to hold onto the bait long enough to be caught. That the public caught proportionally more male crabs than us is highly suggestive of this, since in other crab species males tend to win contests for resources (Briffa & Dallaway, 2007). However, our traps would not have allowed either the winner or loser of such a fight to subsequently leave the area, such that if competition were taking place then the results should be biased against the public being the source of the damage. (3) The greater numbers of injured crabs simply reflects that each group had been crabbing in one area longer than us and so were sampling the area more efficiently. However, table 2 shows, if anything, that traps and buckets deployed for longer had fewer injured crabs.

That Cromer should have a greater level of limb damage is difficult to explain, but it may be due to greater levels of crabbing (Cromer appears to have a larger tourist industry than Wells), or damage caused to crabs as they are flung 30m from the pier into the water. We emphasise that our sampling at Cromer was less intensive than at the other sites, and more work would be required at Cromer.

5.3 The effect: population-level effects

There were no differences in sex ratio or size between the control site and Well harbour, though there was an increase in the proportion of males and in the size of both sexes at Cromer compared with Wells (not shown). However, this is likely because Cromer is deeper and has stronger currents, both factors that are known to affect the sex ratio and average size of shore crabs (Crothers, 1968). Moreover, direct comparisons between crabs caught by tourists at Cromer and Wells are not necessarily valid since the difference in height above sea level between the two sites could affect the catching technique. As a result of the increased height above the sea crabbers

were much less likely to feel or see a crab on their line at Cromer unless it was much larger, and it should be noted that male and female crabs are not, on average, the same size.

However, it is still possible that the size and sex ratios have been affected by crabbing and that confounding factors mask the impacts. In aggressive encounters the strongest (and so to an extent largest) win (Sneddon *et al.*, 1997b), and such individuals are more likely to be red morphs (Reid *et al.*, 1997) although these morphs are less able to cope with hypoxic buckets (Reid & Aldrich, 1989). In contrast, smaller and weaker animals have a lesser inter-molt period and so are able to regenerate a lost limb more rapidly (Crothers, 1967). Thus limb loss may be less costly for these individuals (McVean & Findlay, 1979), although it still affects smaller individuals' mating success more (Abello *et al.*, 1994). It is likely that a later study, perhaps looking at inter-morph variation, would shed light on this matter.

5.4 The solution: the importance of consultation

Given how frequently people claimed to have been crabbing before it was surprising that few of them seemed to even know how many legs a crab had, let alone what species they were collecting. More worryingly, the inability of children to recognise how many legs a crab had suggests that they were not even looking at the crabs they were collecting, and many seemed motivated by the size and number of their specimens, not an interest in the crabs *per se*. Thus it may be difficult to implement measures to reduce the number of crabs kept in each bucket and encourage them to throw the excess back. However, it is encouraging that most of those interviewed expressed an interest in a sign giving information about the crabs. Perhaps the children's motivations will change when in an environment that better facilitates learning about the animals.

To this end, funding was obtained from the Wells Field Center and Norfolk Council to run a flyer campaign giving information about the crabs and how to care for them (see figure 4), in part on the basis of the economic importance of the crabs for Wells-next-the-Sea revealed by our questionnaire survey. The flyers were given to bait shops in May of 2008, and a number of media outlets covered the story (with varying degrees of sympathy for the project; see these links: BBC Radio 2, The Independent, Daily Mail, The Telegraph, The Metro, The Fakenham Times,). The public were advised to use only seawater (reducing osmotic stress) in their buckets, change the water once every hour (reducing hypoxia), not to leave their buckets in direct sunlight (reducing temperature), to occasionally throw a few crabs back and put at most ten animals in a bucket at one time (based on preliminary analysis of these data).

This work highlights the importance of an integrated approach to any conservation problem. Once we knew the cause of the problem, it was simple to accumulate evidence of the gap in the public's knowledge and of people's interest in plugging that gap. Obtaining funding was relatively simple since we had evidence of the importance of crabbing to the economy and had generated popular interest through the newspaper article. The importance of generating popular and media interest cannot be underestimated in a successful conservation strategy. Moreover, baseline data has been accumulated (and is available online in the supplementary materials) and the same technique can be used to evaluate the effectiveness of the campaign, such that it can be refined and extended if necessary. It is only through integrating the general public into a conservation strategy that it can be successful, for ultimately they are the ones whose views and actions we must alter.

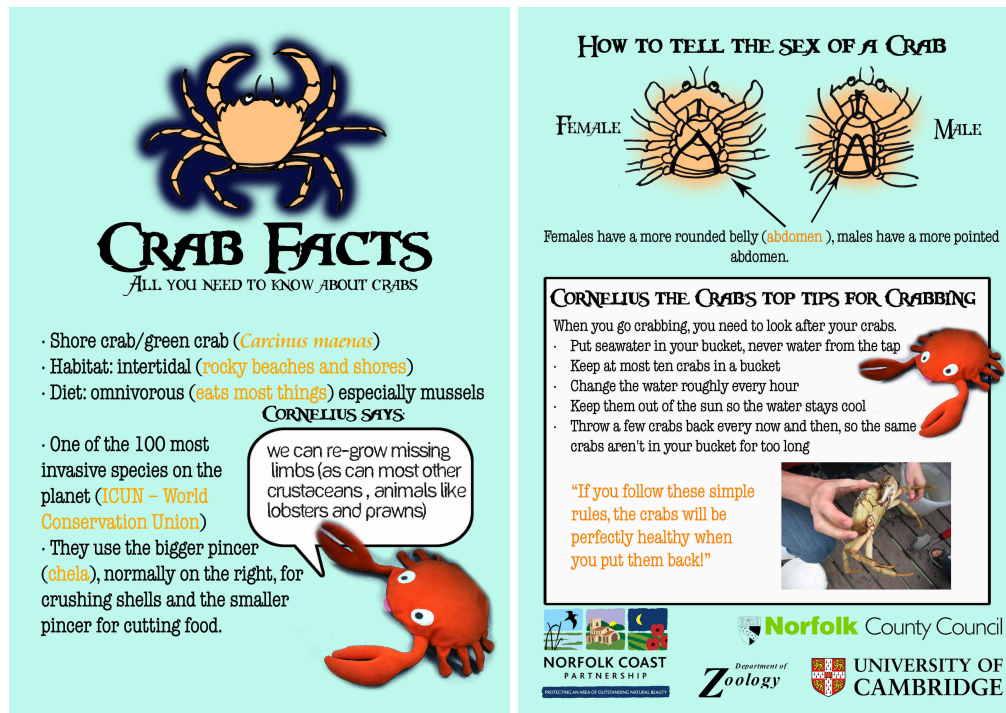


Figure 4: Copy of flyer distributed to tourists as part of campaign (see text).

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This work is dedicated to the memory of Tom Pearse, who died shortly after this fieldwork was conducted. WDP and HG played an equal part in the data collection; this manuscript is a (very slightly) modified version of WDP's undergraduate thesis.

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Appendix—Questionnaire

Due to a lack of resources, individual questionnaires could not be printed out for each interview. Below is a copy of the questions that each field worker asked, and after it the response types/kinds that were recorded. As explained in the text, the questions asked changed part-way through the study and these changes are described below.

1. Where do you live?
Local / county of home city
2. How often have you been crabbing here in the last twelve months?
Integer
3. How long have you been crabbing for so far today?
0-30min, 30min-1hr, 1-2hr, 2hr+
4. How long are you planning to spend crabbing in total today?
0-30min, 30min-1hr, 1hr-2hr, 2hr+ (later changed to 0-30min, 30min-1hr, 1hr-2hr, 2-4hr, 4hr+)
5. (Assessed by field worker) What equipment is being used for crabbing?
Line/net/hook and number of each
6. (Assessed by field worker) What bait is being used for crabbing?
Bacon/sausage/sardine/any combination/etc.
7. How much money are you planning to spend here in total today?
0-5, 5-10, 10-20, 20+ (later changed to 0-5, 5-10, 10-20, 20-30, 30-40, 40+)
8. How many crabs would you be comfortable having in your bucket at any one time?
0, 1-5, 6-10, 10-20, 20+ (later changed to 0, 1-5, 6-10, 10-20, 20-40, 40+)
9. What made you decide to come crabbing here today?
Word of mouth/tradition/impulse (i.e. passing through and saw it)/other
10. What is inside your bucket?
Seawater/freshwater/nothing
11. (Assessed by field worker) What temperature is the water in their crabbing bucket?
12. (Added later) If there were to be a sign put up, giving information about the crabs and how to crab responsibly, how interested (on the scale below) would you be in it?
1(not at all interested) 3(apathetic) 5(very interested)
13. (Added later; without the interviewee looking in the bucket) How many legs does a crab have?
Correct / incorrect
14. (Added later) What is the name of the species of crab youre catching?
Shore crab, green crab, Carcinus maenas all accepted as correct responses